METHOD FOR MAKING AN ELECTRIC OR ELECTRONIC MODULE COMPRISING A GLASS LAMINATE

RELATED APPLICATION

This application is based on provisional application Ser. No. 60/127,478 filed Apr. 2, 1999.

DESCRIPTION

1. Field of the Invention

The present invention relates to a method for making an electric or electronic device such as a flat panel display, a light emitting diode or a photovoltaic cell. More specifically, the present invention relates to a method wherein a thin glass sheet is laminated to a substrate which is provided with one or more functional layers used in such electric or electronic devices, e.g. an electroconductive layer, a colour filter, a liquid crystal alignment layer, a phosphor layer, etc.

2. Background of the Invention

Liquid crystal displays (LCDs) have been used for several years now as an information display in e.g. calculators, watches, video games, audio and video equipment, portable computers, car dashboards, etc., i.e. especially in mobile devices wherein low weight is an important feature. Moreover, quality and size have been improved substantially so that LCDs are becoming an interesting alternative for the cathode ray tubes (CRTs) which are being used widely in television sets and desktop computer displays. In the meantime other flat panel display (FPD) types, such as plasma displays (PDs), field emission displays (FEDs) and organic light-emitting displays (OLEDs) are attracting a lot of attention as potential alternatives of LCDs. Being emissive displays, PDs, FEDs or OLEDs may provide a solution for two major problems associated with LCDs, i.e. the low viewing angle and low efficiency (typically, only a few percent of the incident light or backlight passes through an LCD to form a readable image).

In all these FPDs, two substrates are being used for carrying functional layers, e.g. electroconductive layers for pixel addressing, colour filters, liquid crystal orientation or alignment layers in LCDs or phosphor layers in FEDs and PDs. Between the two substrates provided with said functional layers, there may be applied a filling, e.g. a liquid crystal compound (LCDs), a light-emitting substance (LEDs) or a plasma-forming gas (PDs). After assembling such a panel, one or more foils can be laminated to the s outer surface of the glass substrate. In most LCDs polarisor foils are necessary components which are laminated to the glass substrate. In addition, several other types of foils are widely used to improve the image quality, e.g. retardation film, reflection or anti-reflection foils, foils which improve the viewing angle, light dispersion foils, etc.

The substrates used in such devices are typically glass plates having a thickness in the range from 0.7 to 1.1 mm. Due to the high specific weight of glass, the total weight of a display is mainly determined by the size and thickness of these glass plates. In "Fourth-Generation LCDs - EIAJ Display Forecast", published in "Display Devices", Spring '96, Ser. No. 13, p. 14–19 (published by Dempa Publications Inc., Tokyo), it is emphasised that weight reduction of FPDs is a major need to be investigated. Weight reduction is important for mobile displays as well as for large stationary displays such as television sets and desktop computer displays. A further reduction of the thickness of the glass plates is however limited due to the high brittleness of such thin glass.

For some low-cost applications, plastic sheets are being used as a low-weight substrate of a FPD. The high strength and flexibility of plastics even enables the making of a flexible display. In addition, the flexibility of plastic substrates enables the use of continuous processes for applying a functional layer thereon, e.g. using a web or roll coater or by printing, while the coating on glass typically proceeds in a batch process (sheet by sheet). However, the liquid crystal composition and other functional layers, especially the electroconductive layers, present between such plastic substrates are not well protected from chemicals, oxygen, moisture, mechanical impact and other external influences and, as a result, the lifetime of such plastic-based devices is limited. In addition, plastics have a very low thermal and dimensional stability compared to glass, which are essential properties required for obtaining high quality displays. As a result, quite some research is focused on the development of barrier layers which can be provided on plastic foils to reduce to diffusion of moisture and gases as described in e.g. U.S. Pat. No. 4,950,551; U.S. Pat. No. 5,589,252; and U.S. Pat. No. 5,820,994. Known examples of such barrier layers are the so-called Organically Modified Ceramic layers, as described in Coating, no. 9/98, p. 314 and 10/97, p. 358, and the poly(hydroxy amide ethers) described in Macromolecules, vol. 31, p. 8281 (1998).

As a solution for the above problems, WO99/21707 and WO99/21708 propose to use a laminate as substrate which comprises a glass layer, an adhesive layer and a plastic support. Such glass/plastic laminates combine the advantageous properties of glass and plastics. The glass protects the plastic substrate from scratches, moisture, solvents and gases, and improves the dimensional and thermal stability of the substrate. When a thin glass is used, e.g. a glass as described in EP-A-716339, the glass/plastic laminate is flexible and can be wound around a core, enabling the use of web or roll coating methods. The devices which are obtained using such glass/plastic laminates as substrate are characterised by a lower weight than full-glass based devices and by a lower probability of breakage of the substrate during handling or dropping the device.

Two problems are associated with these glass/plastic laminates. The functional layers needed in electric or electronic devices such as FPDs, photovoltaic cells and LEDs are typically applied on the substrate using methods such as sputtering, photolithography, physical vapour deposition, chemical vapour deposition, etc. During these processes, the substrate is subjected to high temperature and/or chemical treatments with various organic solvents and acid or alkaline solutions. As a result, the glass/plastic laminates described above may curl or even break due to the different thermal expansion coefficient of glass and plastic or the adhesive layer may be degraded so that the bond between the glass and plastic is destroyed. Another problem is associated with the cutting of glass/plastic laminates. At present, FPDs such as LCDs are being manufactured from substrates having a large size up to 500×400 or even 650×550 mm. After assembling the panel, the substrates are cut so as to obtain from two to nine modules (displays cells) from one panel. Using glass/plastic laminates as substrate requires complicated cutting tools, especially when one takes into account that the substrates of an LCD are typically being cut asymmetrically, i.e. the one substrate is cut at a different location than the other so as to obtain a Z-shaped edge.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method of making a module for use in an electric or electronic